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SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science, edited by J. McKeen Cattell and published every Friday by

THE SCIENCE PRESS

11 Liberty St., Utica, N. Y. Garrison, N. Y.

New York City: Grand Central Terminal

Single Copies, 15 Cts.

Annual Subscription, \$6.00

Entered as second-class matter January 21, 1922, at the Post Office at Utica, N. Y., under the Act of March 3, 1879.

VOL. LV MARCH 17, 1922 No. 1420

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DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES IN 1921

THROUGH the generous cooperation of the registrars of the various American universities granting doctorates in the sciences, the Research Information Service of the National Research Council is able to offer the following compilation of doctorates granted during the collegiate year 1920-1921. Through this same cooperation statistics are now available for the period 1916-1919. The information for these three years has not been compiled heretofore and therefore was lacking in the tables as published last year (SCIENCE, 52, 478, 514). These figures are of value as an indication of the academic activity during the World War. As would be expected, the number of doctorates fell off as the size of the American army increased (1917, 372; 1918, 293; 1919, 180). This is a confirmation of the acknowledged fact that the scientific men of the country played an increasingly important part in the activities of the army and navy.

In 1921 there were 332 doctorates conferred in the natural sciences by 32 institutions, as compared with 323 by the same number of institutions in 1920. (The figures reported in 1920 by institutions and by subjects have been corrected in certain cases from later information). It is interesting that the figures for 1917 should be so much higher than those for any other year reported in the tables. How long will it be before those figures are again reached?

Marked changes in the order of institutions are in the shift of Minnesota from nineteenth place in 1920 to tenth place in 1921, and of George Washington from tenth place in 1920 to twenty-sixth place in 1921. Comparisons of this kind are of uncertain significance because the number of degrees granted by an institution during any collegiate year depends upon many factors.

DOCTORATES CONFERRED IN THE SCIENCES BY AMERICAN UNIVERSITIES

	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Chicago -----	37	16	28	53	53	39	55	28	43	42
Cornell -----	28	30	36	26	24	38	30	21	35	33
Columbia -----	36	27	21	27	34	37	24	11	24	27
Yale -----	21	19	13	20	24	25	9	4	23	27
Harvard -----	15	22	28	33	16	39	15	14	28	25
California -----	12	9	11	16	17	23	16	16	14	22
Johns Hopkins --	23	21	18	23	22	24	7	7	21	21
Illinois -----	15	11	18	17	26	24	23	15	22	19
Wisconsin -----	14	5	17	8	22	17	16	9	24	15
Minnesota -----	2	2	3	4	7	9	10	8	4	16
Ohio State -----	5	0	0	1	2	8	7	3	6	8
Princeton -----	7	7	7	4	19	5	8	3	10	8
Iowa -----	3	2	2	2	2	3	9	4	5	7
Mass. Inst. Tech.	6	1	2	2	3	4	4	1	8	7
Michigan -----	8	10	5	15	10	13	8	4	9	7
Clark -----	6	13	7	10	9	12	4	5	4	6
Pennsylvania ---	9	9	5	11	16	7	10	8	5	5
Stanford -----	3	5	2	2	0	4	0	2	4	5
Brown -----	4	1	4	5	2	3	9	2	2	4
Nebraska -----	0	2	1	3	0	2	1	2	0	4
New York -----	2	3	1	3	0	6	0	2	2	4
Radcliffe -----	0	0	0	0	0	1	0	1	1	3
Washingt'n Univ.	1	3	1	5	0	2	2	1	3	3
Bryn Mawr -----	3	0	2	0	3	2	1	1	1	2
Cincinnati -----	1	2	2	0	2	1	1	1	2	2
Geo. Washington	2	1	2	4	5	8	3	3	9	2
N. Carolina -----	0	0	1	2	2	0	1	1	0	2
Pittsburgh -----	1	5	0	4	0	5	1	2	2	2
Catholic -----	1	0	0	2	1	2	4	0	1	1
Indiana -----	4	1	2	4	3	2	4	1	5	1
Kansas -----	0	0	0	0	0	0	0	0	1	1
Syracuse -----	0	0	0	0	0	0	4	0	2	1
Missouri -----	0	1	1	1	3	2	3	0	2	0
Northwestern ---	0	0	0	1	3	3	2	0	0	0
Notre Dame -----	-	-	-	-	-	0	1	0	0	0
Washington -----	-	-	-	-	-	0	1	0	0	0
Virginia -----	2	2	1	0	2	1	0	0	1	0
Boston -----	1	2	0	0	0	1	0	0	0	0
Totals -----	273	234	241	309	332	372	293	180	323	332

DOCTORATES DISTRIBUTED ACCORDING TO SCIENCES

	'12	'13	'14	'15	'16	'17	'18	'19	'20	'21
Chemistry -----	78	68	71	85	115	108	75	54	96	134
Zoology -----	20	26	25	32	33	30	33	24	38	36
Botany -----	30	28	34	40	36	37	39	23	48	29
Physics -----	30	22	23	31	35	32	17	18	19	28
Psychology ----	29	24	12	22	19	32	30	21	38	26
Bacteriology ----	6	3	6	4	4	11	11	6	7	19
Mathematics ----	22	21	25	23	34	30	23	7	19	16
Geology -----	23	14	13	26	17	24	14	5	17	11
Physiology ----	12	2	3	8	14	18	11	1	13	8
Astronomy -----	2	11	2	7	6	5	0	1	4	5
Geography -----	0	1	0	3	3	3	1	0	3	5
Anatomy -----	6	1	2	5	1	3	5	0	3	4
Anthropology ---	0	3	2	6	1	4	2	0	2	4
Agriculture -----	11	8	9	9	6	19	18	12	8	3
Metallurgy -----	0	0	0	1	1	0	1	1	0	2
Engineering ----	2	0	4	2	2	5	4	1	5	1
Pathology -----	2	2	1	2	2	6	8	6	3	1
Mineralogy ----	0	0	0	1	0	0	0	0	0	0
Meteorology -----	0	0	0	0	0	1	1	0	0	0
Paleontology ----	0	0	4	2	3	4	0	0	0	0
Totals -----	273	234	241	309	332	372	293	180	323	332

THESES DISTRIBUTED ACCORDING TO SUBJECT

Agriculture

CORNELL: Charles Loring Allen, "Effect of age of sire and dam on the quality of offspring in dairy cows."

ILLINOIS: Jacobus Stephanus Marais, "Comparative agricultural value of phosphates of aluminium, iron and calcium." William Barbour Nevens, "Amino acid content and nutritive value of proteins of cottonseed meal."

Anatomy

MINNESOTA: Leroy Adelbert Calkins, "Morphometry of human fetus with special reference to obstetric dimensions of the head." Homer Barker Latimer, "Postnatal growth of the body. Systems and organs of the single-comb Leghorn chicken." John Charmley McKinley, "Intraneural plexus of fasciculi and fibers in the sciatic nerve." Hjalmar Laurits Osterud, "Postnatal growth and development of reproductive tract in female albino rat."

Anthropology

CALIFORNIA: Guy Montgomery, "Studies in primitive folksong." Eda Lou Walton, "Navaho traditional poetry."

HARVARD: Andrew Affleck Kerr, "Similarities in material culture between old and new world." Samuel Kirkland Lothrop, "Ceramics of northern Costa Rica and western Nicaragua."

Astronomy

CALIFORNIA: Priscilla Fairfield, "Indeterminate cases of the orbit problem." Hamilton Moore Jeffers, "Investigation of the orbits of the two components of Taylor's comet (1916 I)." Jessica May Young, "Cause of the non-appearance of certain periodic comets on their predicted returns."

CHICAGO: Alice Hall Farnsworth, "Comparison of photometric fields of 6-inch doublet, 24-inch reflector and 40-inch refractor with some investigation of the astrometric field of the reflector." Edison Pettit, "Form and motions of solar prominences."

Bacteriology

CALIFORNIA: Laurence Fleming Foster, "Growth, viability and metabolism of *Streptococcus hemolyticus*."

CHICAGO: Paul Roberts Cannon, "Effects of diet on the intestinal flora." John Everett Gordon, "I. Relationship of pneumococcus to acute infections of upper respiratory tract in man. II. Gram negative cocci in acute infections of the upper respiratory tract." Bernard Wernick Hammer, "Volatile acid production of *S. lac-*

- ticus* and the organisms associated with it in starters."
- CORNELL: Aaron Bodansky, "Enzyme studies on *Solanum elaeagnifolium*." Charles Milton Carpenter, "Bacteriology of female reproductive organs of cattle and its relation to diseases of calves." Harrison August Ruehe, "Effect of the process of manufacture on germ content of bulk condensed milk." William Alonzo Whiting, "Possible relationship existing between the grouping of bacteria in market milk and the utensil flora."
- HARVARD: Boris Aronovitch, "Soluble toxic substances produced by the organisms of the colontyphoid group." George Hoyt Bigelow, "Allergy in pneumonia as evidenced by intracutaneous reaction." Leland David Bushnell, "Bacteria found in spoiled canned asparagus." Dwight Lewis Sisco, "Epidemiological study of food poisoning."
- JOHNS HOPKINS: Howard Benjamin Cross, "Phagocytosis in relation to terminal infections."
- KANSAS: Noble P. Sherwood, "Studies on complement."
- MASSACHUSETTS INSTITUTE OF TECHNOLOGY: Murray Philip Horwood, "Investigation of public health and sanitation of certain urban communities in Oklahoma."
- MINNESOTA: Winifred Mayer Ashby, "Destruction of transfused blood in normal subjects and in pernicious anemia patients."
- YALE: Harry Asher Cheplin, "Transformation of intestinal flora with special reference to the implantation of *Bacillus acidophilus*." Barnett Cohen, "Effects of temperature and hydrogen ion concentration upon viability of *Bacterium coli* and *B. typhosum* in suspensions in water." Charles Shelby Gibbs, "Factors that govern production of diphtheria toxin in artificial culture media."
- Botany*
- CALIFORNIA: Frederick Monroe Essig, "Morphology, development and economic aspects of *Schizophyllum commune* Fries." Alice Maria Otley, "Revision of Californian species of *Lotus*." Albert Julius Winkler, "Internal browning of the yellow Newtown apple."
- CHICAGO: Scott Verne Eaton, "Sulfur content of soils and its relation to plant nutrition." Hope Sherman, "Respiration of dormant seeds." Perry Daniel Strausbaugh, "Dormancy in the plum."
- CORNELL: Sarkis Boshnakian, "Genetics of squareheadedness and of density and the relations of these to other characteristics in wheat." James Marshall Brannon, "Influence of certain sugars on plants with particular reference to dextrose and levulose." William Moore, "Spreading and adherence of arsenical sprays." Harry Ashton Phillips, "Effect of climatic conditions on fruit trees in relation to blooming and ripening dates." Thomas Wyatt Turner, "Mechanism of physiological effects of certain mineral salts in altering the ratio of top growth to root growth in seed plants." Thomas Kennerly Wolfe, "Biometrical study of characters in maize."
- HARVARD: Edward Franklin Gaines, "Genetics of bunt resistance in wheat." Felix Gustaf Gustafson, "Respiration of certain lower fungi." Herbert Kendall Hayes, "Inheritance in wheat and maize. I. Inheritance of seed and spike characters in crosses between varieties of *Triticum vulgare* Vill. II. Production of high protein maize by Mendelian methods. III. Critical analysis of methods of maize breeding." Ondess Lamar Inman, "Respiration as related to injury and recovery." James Plummer Poole, "Comparative anatomy of the leaf of the Cycads with reference to the cycadofilicales."
- ILLINOIS: Cecil Frederick Patterson, "Growth in seedlings of *Phaseolus vulgaris* in relation to humidity and temperature."
- INDIANA: Flora Charlotte Anderson, "Development of flower and embryogeny in *Martynia Louisiana* Mill."
- IOWA: Raymond Albert French, "Apogamous reproduction of *Lactuca Ludoviciana* (Nutt) Riddell."
- MICHIGAN: Carl Downey LaRue, "Results of selection within pure lines of *Pestalozzia guepini* desm."
- MINNESOTA: Paul Work, "Effects of nitrate of soda on the nutrition of the tomato."
- PENNSYLVANIA: Charles Homer Arndt, "Growth of field corn as affected by iron and aluminium salts."
- STANFORD: L. J. M. BAAS-BECKING, "Origin of vascular structure in the genus *Botrychium*."
- WASHINGTON UNIVERSITY: Robert William Webb, "Germination of spores of certain fungi in relation to hydrogen ion concentration." George Miller Armstrong, "Sulfur nutrition of fungi as affected by hydrogen ion concentration."
- WISCONSIN: Eloise Gerry, "Oleoresin production: Microscopic study of effects produced on the woody tissues of southern pines by different

methods of turpentineing." James Geere Wickson, "Value of certain nutritive elements in development of the oat plant and their relation to chemical composition of grain and straw."

YALE: Albert Frederick Hill, "Vegetation of Penobscot Bay Region, Maine."

Chemistry

BROWN: Samuel Reed Damon, "Bacteria as source of the growth-promoting principle, water-soluble B; identity of water-soluble B and the antineuritic vitamine."

CALIFORNIA: Dwight Cooley Bardwell, "Hydrogen as a halogen in metallic hydrides." Theophil Frederic Buehrer, "Critical solution temperatures of white phosphorus with various liquids." Paul Steere Burgess, "Drained marsh soil, unproductive for peas." William Henry Hampton, "Potential of the iron electrode." Thorfin Rustin Hogness, "Surface tensions and densities of liquid mercury, cadmium, zinc, lead, tin, and bismuth." Sherwin Maeser, "Physical and chemical properties of some tertiary amine-oxide derivatives."

CHICAGO: Steward Basterfield, "Derivatives of isourea and their pharmacological action." Henry Leon Cox, "Derivatives of linolic acid." Frank Louis DeBeukelaer, "Derivatives of phenylethyl- and phenyldiethylacetic acids." Lillian V. Eichelberger, "Transformation of maleic to fumaric acid." Warren Walter Ewing, "Attraction of mercury for other liquids." Leo Finkelstein, "I. Determination of radium in meteorites by the emanation method. II. Measurement of ranges of alpha particles by modified Bragg apparatus." Aubrey Chester Grubb, "Chemical reactions in the corona." Robert Stern Landauer, "Triatomic hydrogen." Louis Melvin Larsen, "I. Nitrotriphenylamines. II. Oxidation of diaminophenols." George Ross Robertson, "Organic derivatives of arsenic." Frank V. Sander, "Preparation and resolution of *dl*-l, 3-dihydroxybutyric acid." James H. C. Smith, "I. Estimation of sodium hyposulfite. II. Arsenic derivatives of phenylaminoacetic acid." Herman Vance Tartar, "Constitution of murexide and theory of dyes." Harry Benjamin VanDyke, "Study of distribution of iodine in thyroid gland." Edgar Wertheim, "Preparation of *dl*-*p*-sec-butylphenylhydrazine. Resolution of *dl*-*p*-sec-butylaniline." Ying Chang Cheng, "Cohesion, adhesion, tensile strength, tensile energy, negative surface en-

ergy, interfacial tension and molecular attraction."

CINCINNATI: Joseph Laurence Donnelly, "Quantitative study of the action of monochloroacetic acid upon various amines." Edward Charles Mason, "Pharmacological action of lead in organic combination."

CLARK: Charles Buell Hurd, "Equilibria between calcium, hydrogen and nitrogen." Walter William Lucasse, "Specific conductance of concentrated solutions of sodium and potassium in liquid ammonia." Edward Zeitfuchs, "Vapor pressure of mixture of ammonia and xylene in neighborhood of their critical solution temperature. Molecular weight of sodium tellurium complex in liquid ammonia."

COLUMBIA: Howard Adler, "Formation of addition compounds between formic acid and metallic formates; factors affecting stability of these compounds." David John Beaver, "Effect of certain electrolytes on stabilizing and precipitating gold sols." Jacob Julius Beaver, "Compound formation in phenol-cresol mixtures." Mary Letitia Caldwell, "Experimental study of certain diamino acids." Arthur William Davidson, "Formation of addition compounds between sulfuric acid and metallic sulfates." Te Pang Hou, "Iron tonnage." Norma Eva Johann, "Composition of ammonium phosphomolybdate and the determination of phosphorus." Samuel Jacob Kiehl, "Hydration of sodium metaphosphate to orthophosphate in varying concentrations of hydrogen ion at 45°." Victor Kuhn La Mer, "Effect of temperature and concentration of hydrogen ions upon rate of destruction of the antiscorbutic vitamine." Leland Judson Lewis, "Hydrolysis of fats by reagents made from cymene." Ernest Elmer Lyder, "Thermal decomposition of oil shale." Alice R. T. Merrill, "Experimental studies of cystine." Martin Meyer, "Dehydrothiotoluidine, its isomers, homologues, analogues and derivatives." William Alvin Mudge, "Saturated potassium chloride calomel cell." Francisco A. Quisumbing, "Conditions affecting determination of reducing sugars by Fehling solution." Harold Lester Simons, "Mechanism of hydrolysis of sucrose by invertase." Jesse Wilbur Stillman, "Determination of copper by electrolytic deposition." Paul Miller Giesy, "Placental hormone."

CORNELL: Archibald Mortimer Erskine, "Reaction between hydrazine and hydrogen per-

- oxide." Axel Ferdinand Gustafson, "Effect of drying soils on water-soluble constituents." Archie Bernhard Hoel, "Edison storage cell." Howard Campbell Jackson, "Neutralization of cream for buttermaking." Stuart Deming Jackson, "o-Cresolsulfonphthalein and some of its derivatives." Louise Kelley, "p-Hydroxybenzoyl-o-benzoic acid and some of its derivatives." Alexander McTaggart, "Influence of certain fertilizer salts on the growth and nitrogen content of some legumes." John Graham Thompson, "Removal of silicon from zirkite ore in the electric furnace."
- GEORGE WASHINGTON: Carl D. Garby, "Hydrogen ion concentration and acidity of corn meal undergoing spoilage."
- HARVARD: Goodwin LeBaron Foster, "Glucose to nitrogen ratios of the phlorhizinized dog, cat and rabbit and the depancreatized dog." Lee Irvin Smith, "I. Addition reactions of unsaturated ketones. II. Bromination of acetoacetic ester. III. Action of alkalis on nitrocyclopropanes." Charles Phelps Smyth, "Solid thallium amalgams." Benjamin Leslie Souther, "I. Hydroxypyridines. II. δ -Ketonic nitriles." Philip Francis Weatherill, "I. Change in volume of potassium chloride upon solution in water. II. Revision of the atomic weight of silicon."
- ILLINOIS: Manson James Bradley, "Decomposition processes applicable to certain products of coal carbonization." John Bernis Brown, "The highly unsaturated fatty acids of fish oils." George Hopkins Coleman, "Action of nitrogen trichloride on ethyl chloride, benzene, toluene and benzyl chloride." Max Shaw Dunn, "Preparation, properties and metabolic behavior of deaminized proteins." Robert Edman Greenfield, "Chemical reactions in water purification using the hydrogen electrode." John Abderdeen Gunton, "Reinvestigation of the proximate composition of *Rhamus frangula*." Leonard Francis Yntema, "Ultra-violet are spectrum of yttrium."
- JOHNS HOPKINS: William Herbert Bahlke, "Vapor pressure of aqueous solutions of lithium chloride at 20° C." David Charles Jones, "Ternary critical solution temperatures as criteria of liquid purity." John Fitch King, "Structure of liquid mixtures from the standpoint of dielectric constant refractive index density." Simon Klosky, "Silica and impregnated silica gels." Isaac Newton Kugelmass, "Rate of solution of colloidal ferrie hydroxide." William Lloyd Linton, "Compressibility of liquids and mixed organic liquids." Benjamin Simon Neuhausen, "System ammonia-water as a basis for the theory of the solution of gases in liquids." Hugh Klemme Parker, "Vapor pressure of aqueous solutions of cane sugar at 20° C." Florence Powdermaker, "Prematurely senile rats." James Edwin Sharp, "Proposed method for obtaining a constant measurable surface of mercury for measuring absolute adsorption."
- MASSACHUSETTS INSTITUTE OF TECHNOLOGY: John Campbell, "Continuous process for production of perchlorates from alkali chlorides." William Richard Hainsworth, "Effect of high pressures on the hydrogen-calomel galvanic cell." David Burger Joubert, "Equation of state for methane." Max Knobel, "Activities of the ions of potassium hydroxide in aqueous solution." Melville Johnston Marshall, "Heat of adsorption of gases and vapors on charcoal." Charles Baldwin Sawyer, "Nitrogen in steel."
- MICHIGAN: Frederick Franklin Blicke, "Quinoidation in the triarylmethyls and in the salt-like derivatives of the triaryl carbinols." Dwight Clark Carpenter, "Anomalous osmose of electrolytes with colloidion membranes." Wesley George France, "Transference numbers of sulfuric acid and the influence of gelatin on transference numbers by the concentration cell method." Roy Kenneth McAlpine, "Atomic weight of antimony." Frederick William Sullivan, Jr., "Diphenyl- α -naphthylmethyl and the color of free radicals." Frederick Hawley Currens, "Separation of old ytterbium from gadolinite."
- NEBRASKA: Thos. Jefferson Thompson, "Substituted succinic acids and reactions of benzyl cyanide."
- NEW YORK: Ernest Raymond Lilley, "Some relations between petroleum and coals, and their application." Thomas Marshall Smith, "Hydrated oxalic acid as an analytical standard." George Watkins Wilson, "Catalytic oxidation of benzene."
- NORTH CAROLINA: Troy Monroe Andrews, "New derivatives of 2, 3, 8-tribromojuglone." Iva Welborn Smithey, "Bromination of 2-amino-p-cymene."
- OHIO STATE: Carlton Edgar Curran, "Reactions of nitrosophenol and N-chloroquinonimine with aromatic amines." Ora L. Hoover, "Oxidation of acetol." Samuel Morris, "Potassium

- dichromate and iodine as ultimate standards in analytical chemistry." Charles Ferdinand Rudmann, "Oxidation of methane." Lily Bell Sefton, "Oxidation of acetone and isopropyl alcohol."
- PENNSYLVANIA: Ernest Carl Wagner, "Methylation of *p*-aminophenol by formaldehyde."
- PITTSBURGH: Harvey Gerald Elledge, "Solubility of the calcium and magnesium salts of palmitic, stearic and oleic acids." Frederick Horace Garner, "Carbonization of lubricating oils in internal combustion engines."
- PRINCETON: Robert Martin Burns, "Adsorption of gases by metallic catalysts." Gregg Dougherty, "Hydrogenation of benzene." Charles DeWitt Hurd, "Rearrangements of some new hydroxamic acids related to heterocyclic acids and to diphenyl and triphenylacetic acids." Harvey Alexander Neville, "Catalysis in the interaction of carbon with steam and with carbon dioxide." Robert Norton Pease, "Analysis of molecular volumes from the point of view of the Lewis-Langmuir theory of molecular theory."
- RADCLIFFE: Alice Helen Graustein, "Action of halogens and of halogen acids on a δ -ketonic nitrile."
- STANFORD: Neil Preston Moore, "Comparative study of fractionating still-heads." Norris Watson Rakestraw, "Chemical factors in fatigue. I. Effect of muscular exercise upon certain common blood constituents."
- WASHINGTON: Edwin Blake Payson, "Thelypodium and its immediate allies."
- WISCONSIN: Frederick Lincoln Browne, "Thermal chemistry of colloids. II. Heat of coagulation of ferric oxide hydrosol with electrolytes." Alfred E. Koehler, "Protein sulfur." Roland Edward Kremers, "Azulene and other constituents of the volatile oil of milfoil." Henry Baldwin Merrill, "Separation of certain acidic oxides with selenium oxychloride." Frank Wilson Parker, "I. Methods of studying the concentration and composition of the soil solution. II. Classification of the soil moisture." John Henry Schmidt, "Action of arsenic acid and arsenous chloride upon aniline and the preparation of phenarsazine oxide and its derivatives." Hosmer Ward Stone, "Preparation of pure selenic acid; determination of indices of refraction of selenic and selenous acids." Alvin Strickler, "Electric endosmose." William John Trautman, "Reduction of certain compounds by means of silicon."
- YALE: Laura Tuttle Cannon, "Condensation of citral with certain ketones and the synthesis of some new ionones." George Raymond Cowgill, "I. Vitamine-B and the secretory functions of glands. II. Relation between vitamine-B and the nutrition of the dog." Edwin John Fischer, "Synthesis of β -chloroallyl chloride from dichlorhydrin." Zalia Jencks Gailey, "Regeneration of blood, with particular emphasis on the iron factor." Francois Archibald Gilfillan, "Catalytic study of some dehydration and addition reactions of ethyl alcohol." Henry Rudolf Henze, "Factors influencing condensation of hydantoins with compounds containing the carbonyl group." William John Horn, "Mechanism of alkylation in the pyrimidine series." Edward Benedict Hunn, "Utilization of *p*-dichlorobenzene for syntheses in the diphenic acid series." Erwin Burr Kelsey, "Synthesis of thiohydantoins from alkyl-substituted aminoacetanilides." Helen Swift Mitchell, "Choice between adequate and inadequate diets as made by rats and mice." Edith Holloway Nason, "Utilization of oil of cassia for the synthesis of cinnamyl alcohol." William Thornton Read, "Methods of synthesizing hydantoin compounds possessing hypnotic action." Robert Chester Roberts, "Chemical and pharmacological study of some new derivatives of diphenic acid."

Engineering

- CORNELL: Nee Sun Koo, "Investigation of the one-hinged steel arch and its comparison with other types."

Geography

- CHICAGO: Robert Swanton Platt, "Resources and economic interests of the Bermudas." Helen Mabel Strong, "Geography of Cleveland."
- NEW YORK: Alfred Marius Nielson, "Economic geographic conditions influencing seaport development in the U. S."
- YALE: George McCutcheon McBride, "Land tenure in Latin America." Stanislaus Thomas Novakovsky, "Climate and weather of the Russian Far East."

Geology

- BRYN MAWR: Helen Morningstar, "Fauna of the Pottsville formation of Ohio below the Mercer limestones."
- CALIFORNIA: Alfred Russell Whitman, "Re-study of the Cobalt district."
- CHICAGO: George Charlton Matson, "Phosphate deposits of Florida."

COLUMBIA: Harold Lattimore Alling, "Mineral-ography of the feldspars."

IOWA: Walter Henry Schoewe, "Origin and history of the extinct Lake Calvin, Iowa."

JOHNS HOPKINS: Edmund Maute Spieker, "Molluscan fauna of the Zorritos formation of northern Peru."

NEBRASKA: Jerome Benjamin Burnett, "Geological study of northeastern Coahuila, Mexico."

OHIO STATE: Guy Woolard Conrey, "Geology of Wayne County, Ohio."

WISCONSIN: William Oscar Blanchard, "Geonomic interpretation of the cuesta of southwestern Wisconsin." Clifton Sherwin Corbett, "Some hydrous aluminium silicates as schist-making minerals."

YALE: Malcolm Havens Bissell, "Triassic area of the new Cumberland Quadrangle, Pennsylvania."

Mathematics

CALIFORNIA: Nina May Alderton, "Involutionary quartic transformation in space of four dimensions." Paul Harold Daus, "Normal ternary continued fraction expansions for the cube roots of integers." Daniel Victor Steed, "Lines on the hypersurface of order $2n-3$ in space of n dimensions."

CHICAGO: Mayme Irwin Logsdon, "Equivalence and reduction of pairs of hermitian forms." Irwin Roman, "Transformation of waves through a symmetrical optical instrument." William L. G. Williams, "Fundamental systems of formal modular seminvariants of the binary cubic." Frank Edwin Wood, "Certain relations between the projective theory of surfaces and the projective theory of congruences."

COLUMBIA: Jesse Douglas, "Certain two-point properties of general families of curves: the geometry of variations."

ILLINOIS: Beulah May Armstrong, "Mathematical induction in group theory." William Edmund Edington, "Abstract group definitions and applications."

IOWA: Eugene Manasseh Berry, "Diffuse reflection."

JOHNS HOPKINS: Flora Dobler Sutton, "Certain chains of theorems in reflective geometry."

PRINCETON: Philip Franklin, "Four color problem."

RADCLIFFE: Rachel Blodgett, "Determination of the coefficient in interpolation formulæ and a study of the approximate solution of integral equations."

SYRACUSE: Jung Sun, "Some determinant theorems."

YALE: Malcolm Cecil Foster, "Rectilinear congruences referred to special surfaces."

Metallurgy

COLUMBIA: Sze-Moo Ling, "Refractory materials from the viewpoint of binary and ternary equilibrium diagrams."

GEORGE WASHINGTON: Raymond W. Woodward, "Manufacture and properties of steel plates containing zirconium and other elements."

Pathology

MINNESOTA: Charles Edward Nixon, "Substance concerned in the colloidal gold test and the nature of the reaction."

Physics

CALIFORNIA: William Harry Bair, "Spectra of some compound gases in a vacuum tube."

CHICAGO: Ira Garnett Barber, "Secondary electron emission from copper surfaces." Otto Koppius, "Comparison of thermionic and photoelectric work-functions in platinum." Louallen Frederick Miller, "Pressure shifts in a calcium arc." John Preston Minton, "Sensitivity of normal and defective ears for tones of various frequencies."

CORNELL: Jacob Roland Collins, "Influence of certain dissolved substances on the infra-red absorption of water." Guy Everett Grantham, "Study of some infra-red absorption spectra." Lewis Richard Koller, "Factors influencing the resistance of sputtered platinum films."

HARVARD: Hector John MacLeod, "Variation with frequency of the loss of energy in dielectrics."

ILLINOIS: Charles Steven Fazel, "Time and pressure measurements in the corona." Charles Francis Hill, "Measurement of mercury vapor pressure by means of the Knudsen pressure gauge."

JOHNS HOPKINS: Gregory Breit, "Behavior of inductance coils at frequencies of radiotelegraphy." Robert Allen Castleman, Jr., "Magnetic rotary dispersion in transparent liquids." Louis Bryant Tuckerman, "Theory of columns of ductile materials." Jan Stephanus van der Lingen, "Fluorescence of mercury vapor." Milton Sheldon Van Dusen, "Thermal conductivity of some heat insulators."

MINNESOTA: John George Frayne, "Anilateral dynamic characteristics of three electrode thermionic amplifiers." Ada Frances Johnson, "Method of measuring ionic mobilities by ob-

- servations on the self-repulsion of ions." Joseph Valasek, "Piezo-electric activity of Rochelle salt under various conditions."
- NEBRASKA: Leo Gerard Raub, "Study of the cathode fall in helium and argon with wire cathodes."
- OHIO STATE: Alva Wellington Smith, "Measurement of inductance and capacity by an electrometer method. Effect of a superposed constant magnetic field upon the alternating current permeability and energy losses in iron."
- PENNSYLVANIA: Anton David Udden, "Ionization potential of selenium."
- PRINCETON: Henry DeWolf Smyth, "Radiating potentials of nitrogen."
- STANFORD: Frank Clark Hoyt, "Intensities of X-rays of the L-series III. Critical potentials of the platinum and tungsten lines."
- WISCONSIN: Grover Rawle Greenslade, "Spectral distribution of the energy radiated from metallic surfaces at high temperatures."
- YALE: John Stuart Foster, "Relative intensities of the Stark effect components of lines in the spectrum of helium." Elias Klein, "Spark spectrum of gallium in air and in hydrogen." Irvin Henry Solt, "Dispersion of a limited wave train."

Physiology

- BROWN: Edgar Allen, "Oestrous cycle in the mouse." James Walter Wilson, "Biochemistry of vitamine-A."
- CHICAGO: Thomas Leon Patterson, "Gastric contractions in amphidia and reptilia."
- CLARK: Samuel Ernest Pond, "Velocity of contraction-wave in muscle."
- COLUMBIA: Albert Baird Hastings, "Physiology of fatigue; physico-chemical manifestations of fatigue in blood." Ethel W. Wickwire, "Reciprocal reaction in the cardio-vascular system."
- CORNELL: John Stephens Latta, "Histogenesis of dense lymphatic tissue of the intestine (*Lepus*); development of lymphatic tissue and blood-cell formation."
- MINNESOTA: Chester Arthur Stewart, "Vital capacity of lungs of children in health and disease."

Psychology

- BROWN: Sze-Chen Liao, "Quantitative study of non-intellectual elements."
- CALIFORNIA: Dorothy M. H. Yates, "Study of some high school seniors of exceptional intelligence."
- CHICAGO: Forrest Alva Kingsbury, "Group intelligence scale for primary grades." Helen

Lois Koch, "Influence of mechanical guidance upon maze learning." Katherine Eva Ludgate, "Effect of manual guidance upon maze learning." Margaret Wooster, "Certain factors in the formation of new spatial coordination."

CLARK: Carroll Cornelius Pratt, "Qualitative aspects of bitonal complexes." Matsusaburo Yokoyama, "Affective tendency as conditioned by color and form."

COLUMBIA: Florence Edith Carothers, "Psychological examinations for college freshmen." Margaret Evertson Cobb, "Adenoids and diseased tonsils; their effect upon general intelligence." Herbert Wesley Rogers, "Some empirical tests in vocational selection."

CORNELL: Anna Kellman Whitechurch, "Illusory perception of movement on the skin."

HARVARD: Harrison LeRoy Harley, "Development of psychological tests for office clerks." Joseph Paul Hettwer, "Studies on the conditioned reflex." William Moulton Marston, "Systolic blood pressure and reaction-time symptoms of deception and of constituent mental states."

IOWA: Cordia C. Bunch, "Measurement of acuity of hearing throughout the tonal range." Glenn Newton Merry, "Voice inflection in speech." Hazel Martha Stanton, "Inheritance of specific musical capacities." Benjamin Franklin Zuehl, "Measurement of auditory acuity with the pitch range audiometer."

JOHNS HOPKINS: Curt Paul Richter, "Behavior of the rat."

MINNESOTA: Raymond Otto Filter, "Character traits." Oscar Julius Johnson, "St. Paul non-verbal intelligence examination for primary pupils." Calvin Perry Stone, "Analysis of the congenital sexual behavior of the male albino rat."

PENNSYLVANIA: Karl Greenwood Miller, "Diagnostic study of fifty college students." Morris Simon Viteles, "Job specifications and diagnostic tests of job competency designed for auditing division of street railway company."

YALE: Willard Arthur Goodell, "Behaviorism and teleology."

Zoology

- BRYN MAWR: Hope Hibbard, "Cytoplasmic inclusions in the eggs of *Echinarachnius parma*."
- CALIFORNIA: William Ferguson Hamilton, "Coordination in the starfish."
- CATHOLIC UNIVERSITY: Aloysius Fromm, "Vitreous body,—its origin, development and structure as observed in the eye of the pig."

- CHICAGO: James William Buchanan, "Control of head formation in planaria by means of anesthetics." John Wood MacArthur, "Comparative study of susceptibility in planaria and other forms by means of electrolytes and vital dyes."
- COLUMBIA: Robert Hall Bowen, "Insect spermatogenesis. History of cytoplasmic components of the sperm in *Hemiptera*."
- CORNELL: Hazel Elisabeth Branch, "Internal anatomy of *Trichoptera*." John D. Detwiler, "Biology of three little known clover insects." Dean L. Gamble, "Morphology of ribs and transverse processes in *Necturus maculatus*." Harry Hazelton Knight, "Insects affecting the fruit of the apple with particular reference to the characteristics of the resulting scars." Rowland Willis Leiby, "Polyembryonic development of *Copidosoma gelechiæ* with notes on its biology." Mortimer Demarest Leonard, "Revision of the dipterous family *Rhagionidæ* (leptidæ) in the United States and Canada." John Thomas Lloyd, "Biology of North American caddis worms." Helen Elizabeth Murphy, "Metamorphosis of may-fly (*Ephemera*) mouth-parts."
- HARVARD: Samuel Wood Chase, "Mesonephros and urogenital ducts of *Necturus maculosus rafinesque*." William Harder Cole, "Transplantation of skin in frog tadpoles." Emmett Reid Dunn, "Salamanders of the family *Plethodontidæ*." Cleveland Sylvester Simkins, "Origin and migration of so-called primordial germ cells in the mouse and rat." George Carlos Wheeler, "Larvæ of subfamilies *Dolichoderinæ* and *Formicinæ*; developmental stages of ants."
- ILLINOIS: Florence Sander Hague, "Studies on *Sparganophilus Eisei Smith*." Ada Roberta Hall, "Effects of oxygen and carbon dioxide on the development of certain cold blooded vertebrates." Ezra Clarence Harrah, "North American Monostomes." Lewis Bradford Ripley, "Morphology and postembryology of *Noctuid* larvæ." Fenner Satterthwaite Stickney, "Head capsule of *Coleoptera*."
- JOHNS HOPKINS: John Graham Edwards, "Effect of chemicals on locomotion in amœba." Alphonse M. Schwitalla, "Influence of temperature on the rate of locomotion in amœba."
- MICHIGAN: Horace Burrington Baker, "Distribution of mussels in Douglas Lake."
- MINNESOTA: George Henshaw Childs, "Digestive system of diplopods with special reference to *parajulus*." Samuel Alexander Graham, "Influence of physical factors of the environment on the ecology of certain insects in logs."
- OHIO STATE: Carl John Drake, "Ecological and life-history studies of *Heteroptera*."
- PRINCETON: Orren Williams Hyman, "Dimorphism of the spermatozoa of *Fasciolaria Tulipa*."
- RADCLIFFE: Esther Wadsworth Hall, "Braconids parasitic on aphids and their life history."
- STANFORD: K. Kunhi Kannan, "Function of the prothoracic plate in *Mylabrid* (Bruchid) larvæ."
- WISCONSIN: Sarah Van Hoosen Jones, "Inheritance in pigeons; checks and bars and other modifications of black."
- YALE: John Spangler Nicholas, "Regulation of posture in the forelimb of *Amblystoma punctatum*." Leon Stansfield Stone, "Development of the cranial ganglia and the lateral line sense organs in *Amblystoma punctatum*."

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RESEARCH INFORMATION SERVICE,

NATIONAL RESEARCH COUNCIL,

DECEMBER 7, 1921

THE ORGANIZATION OF KNOWLEDGE

II

The aim of all organized knowledge is to increase the certainty of prediction, or as a practical question the science of forecasting, the urgency of which was never more apparent than it is to-day. As has been said by Jevons, "With the progress of any branch of science the element of chance becomes much reduced," for "Not only are laws discovered which enable results to be predicted . . . but the systematic examination of phenomena and substances leads to important and novel discoveries which can in no sense be said to be accidental." The application of this principle to the science of human relations is obvious, yet rarely recognized with the required degree of clearness. A vast amount of human activity continues to be carried on, crude as it may be, in disregard of past experience but of necessity as an adventure or speculation, the evil results of which are most likely to fall upon others than those directly concerned. It is not only